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ABSTRACT

This study investigated the relationship between learning styles, classroom behaviors, ability levels, and academic achievement in an open classroom kindergarten setting. Thirty subjects were selected (ten children from each of the 4-, 5-, and 6-year-old groups). Each child was tested on the following measures: Matching Familiar Figures (MMF); Matrix Solution (MS); Classroom Behavior (SCAN); Stanford-Binet Intelligence Scales, Form U-P; and the Peabody Individual Achievement Test (PIAT). The most important finding was the identification of a cluster of classroom behaviors that negatively affect academic achievement: inattentiveness, high level of gross motor behavior, dependency, passivity, low social interaction, and aggression. These negative behavioral styles suggest a pattern of disorganization and immaturity and stand apart from the general and expected relationship of mental and chronological age with a variety of school-related variables. It is suggested that a different classroom structure or learning environment could yield different results. (CS)

Final Report

# Relationship Between Learning Styles and Academic Achievement

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## Preface

This research was carried out under a contract to the Frank Porter Graham Child Development Center from the North Carolina State Board of Education. The opinions stated are those of the authors and do not represent the positions or policies of the granting agency.

During the spring of 1974, the research staff of the FPG Center conducted a series of four studies which related to the quality and improvement of kindergarten programs in North Carolina. The study described herein was the first in this series.

All subjects in the studies were students (or their parents) in the multi-age, open classroom housed in the research building at the Frank Porter Graham Child Development Center in Chapel Hill, North Carolina. The class was composed of 60 children, of whom there were 10 four-year-olds, 29 five-year-olds, and 21 six-year-olds. The four-year-old children participate in a kindergarten program supported by the Center; however, the other children are public school students. Ninety-three percent of the parents agreed for their children to be involved in the studies.

The authors appreciate the assistance and cooperation provided by the Chapel Hill-Carrboro Public Schools and the Division of Research in the North Carolina State Department of Public Instruction.

# Relationship Between Learning Styles and Academic Achievement

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The purpose of the present study was to investigate the relationship among learning styles, classroom behavior, ability level, and academic achievement in an open classroom kindergarten setting. The term learning style has been used to describe stable patterns of classroom behavior and/or individual preferences in the way children organize and process information during a learning task (Kagan, Moss and Siegel, 1963). One of the major objectives of the informal teaching approach is to create a learning environment and instructional program which accomodates a wide range of individual differences among students (Kohl, 1969; Rathbone, 1971). This objective is based on the assumption that learning proceeds more effectively when instruction is consistent with the child's interest and unique styles of responding. At the same time, there has been very little research on the relationships between student learning styles and academic progress in open classrooms (Greenberg and McKinney, 1972).

One aspect of learning style which has been shown to be an important determinant of academic progress is "conceptual tempo" (Kagan and Kogan, 1970). Some children have been shown to approach problems in a careful, reflective fashion, while others tend to respond in a hasty, impulsive fashion. Impulsive children have been found to make more errors than reflective children on a variety of problems involving tasks and generally earn lower reading and math scores on achievement tests (Kagan and Kogan, 1970). Also, Messer (1970) found that boys who failed a grade between the

ages of six and eight years were significantly more impulsive than their peers, although they were highly comparable in verbal intelligence.

In addition to the tempo of responding, students also display different types of strategies for obtaining and processing information from the learning environment. Several techniques are now available that permit the investigation of strategy behavior in young children which yield measures of the way they form concepts and use information to solve complex problems (Haskins and McKinney, 1974). For example, in a recent study McKinney (1974) gave groups of second graders a series of problems in which they were to identify the correct flower in a matrix of 16 flowers by asking questions that could be answered as yes or no. Reflective children more often grouped the stimuli according to abstract concepts and obtained more information with their questions than impulsive children. Impulsive children were more likely to ask concrete questions and tended to process information in a random, trial-and-error fashion.

In recent years several studies have found an association between the frequencies of specific task-oriented and social behaviors in classrooms and achievement in elementary school children (Cobb, 1972; Lahaderne, 1968; McKinney, Mason, Perkerson and Clifford, 1974; Schaefer, 1971). In general, these studies suggest that children do display stable individual differences in behavioral styles, and that the child who is attentive, independent and task-oriented in his interaction with peers is more likely to succeed academically than the child who is distractible, dependent and passive in peer-group activities. At the same time, it is not clear from these studies how the classroom environment influences behavioral styles, or at what point in a child's school experience they begin to influence his

learning.

Therefore, although considerable progress has been made in describing several aspects of cognitive style in elementary school children, little information is available concerning the development of these styles during the early childhood period. Even less is known about the behavior styles of young children in open classroom settings. The goals for the present study were to explore the behavioral correlates of academic achievement in kindergarten children and to assess the relationships among several measures of cognitive style, ability level and achievement in open classrooms.

## Method

### Subjects

The thirty subjects were selected from the open classroom in the Frank Porter Graham Child Development Center Research Building. Ten children were chosen from each of the four-, five-, and six-year-old groups. The four boys and six girls from the four-year-old group comprised the entire sample. For the five- and six-year-old children, however, five boys and five girls each were randomly selected.[1] The only restriction in addition to sex was that the proportion of black children in the experimental group reflect either that of the classroom (25 percent) or of the Chapel Hill-Carrboro Public Schools (30 percent).

Of the thirty children, 30 percent were black; 70 percent, white. Socioeconomic status was calculated by employing collapsed categories of the Hollingshead Index. Within the sample, 12 of the families were classified

[1]Two children were withdrawn from school before all the data were gathered. Another two children were then randomly selected.

as upper class (with most fathers having Ph.D. or M.D. degrees); 15, as middle class; and only 3 as lower class. The mean I.Q. for the sample was 113. For the means and standard deviations of the performance of the entire sample on all the variables, see Table 2 in this text.

Procedure

Each child was tested on the following measures:

1. Matching Familiar Figures Test(MFF). In this test the child is shown a standard stimulus and six similar variants. The subject is asked to point to the one variant which is identical to the standard. If the child points to an incorrect variant, he is informed of the error and the instructions are repeated. For example, on one item the child was shown a picture of a tree. Below the picture was a card on which there were pictures of six trees, five of which were almost exactly like the stimulus picture, and one which was identical to it. Each subject solved 12 match-to-sample problems. The dependent measures were average latency to first choice and the total number of errors for the 12 items.

2. Matrix Solution (MS). The stimuli for this task were 8 flowers which varied according to size (large or small), color (red or blue), and number of petals (four or six). The stimuli were arragned in a 2 x 4 matrix on a card. The child was told that in this game he must locate the correct flower by asking questions that could be answered as "yes" or "no". He was told that he could ask any question he wanted to so long as it could be answered by either yes or no, but that he was to try to ask as few questions as pos ible.

Strategy behavior was scored by computing the expected reduction in uncertainty in bits of information for each question. For example, if the

Table 2

Means and Standard Deviations over all Subjects on all Variables

| | Variables | $\bar{x}$ | s |
|---|---|---|---|
| 1. | Chronological Age in Months (CA) | 70.26 | 11.24 |
| 2. | Mental Age in Months (MA) | 78.90 | 14.01 |
| 3. | MFF: Mean latency (MFL) | 8.66 | 5.35 |
| 4. | Total errors (MFE) | 19.83 | 6.38 |
| 5. | Matrix Solution: Mean bits of information (MSI) | .648 | .115 |
| 6. | Mean time per problem (MST) | 5.31 | 2.52 |
| 7. | SCAN: Constructive Self-directed Activity(SDA) | 3.47 | 6.86 |
| 8. | Attending/Participation (ATP) | 21.06 | 14.47 |
| 9. | Constructive Play (CP) | 32.10 | 16.59 |
| 10. | Task Interaction (TI) | 13.07 | 12.58 |
| 11. | Social Interaction (SI) | 10.37 | 9.93 |
| 12. | Passive Responding (PR) | 14.00 | 10.54 |
| 13. | Distractibility (DST) | 4.07 | 2.97 |
| 14. | Teacher Interaction (TI) | 1.30 | 2.36 |
| 15. | Gross Motor Behavior (GMB) | 14.97 | 9.34 |
| 16. | Nonconstructive Activity (NCA) | 2.70 | 7.22 |
| 17. | Agression (AGG) | .965 | 1.29 |
| 18. | Dependency (DEP) | 1.93 | 2.47 |
| 19. | PIAT: Mathematics standard score (MSS) | 100.20 | 12.64 |
| 20. | Reading Recognition standard score (RSS) | 109.43 | 16.63 |
| 21. | Mathematics raw score (MRS) | 16.90 | 7.62 |
| 22. | Reading Recognition raw score (RRS) | 19.90 | 8.33 |

subject were to guess one of the eight flowers on the first trial, he would be correct with a probability of 1/8 and would reduce uncertainty by 3.0 bits ($\log_2 8 - \log_2 1$). He would be incorrect with a probability of 7/8 and would gain .19 bits ($\log_2 8 - \log_2 7$). Thus, the informational outcome in each case weighted by the probabilities of occurance would yield an expected information score of .54. If the child guessed one flower at a time in this fashion, his strategy was classified as hypothesis-scanning.

On the other hand, if the child had asked, "Is it red?", on the first trial, the probability that he was correct would be 1/2 and he would reduce the number of possibilities by half with either outcome. This optimal strategy is called focusing and yields an expected information score of 1.0 bits. Thus the information scores could range from zero to 1.0 bits for each response. Any protocal containing questions of both types, i.e., focusing and scanning, would result in an average information score less than 1.0, and was classified as a "mixed" strategy.

3. Classroom Behavior (SCAN). The observational technique was the Schedule for Classroom Activity Norms (McKinney, Mason, Perkerson and Clifford, 1974). Classroom behavior was coded into one of 27 discrete categories every 10 seconds. Each child was observed for five-minute periods on each of four days during the free-choice activity period. Thus, 120 observations were collected for each child. The data were taken by one observer who established inter-observer reliabilities on separate samples by using the percentage-agreement method.

Ten children were observed for five-minute intervals during which 30 observations were recorded for each subject. Percentage of agreement

between the two observers ranged from 90-95 percent with a mean reliability of 91 percent. In addition, 30 observations were made on 3 of the children participating in the experiment. The range of percentage of agreement was from 90-97 percent, with a mean of 95 percent.

4. Stanford-Binet Intelligence Scale, Form L-M.

5. Peabody Individual Achievement Test (PIAT). Each child was administered the Mathematics and Reading Recognition tests of this measure. Standard scores were calculated on norms for the first three months of the next school year for each child so that measures could be obtained for the four-year-olds.

## Results

### Sex Effects

A series of t tests on all the variables listed in Table 1 was conducted to ascertain if there were sex differences in performance. The only significant differences obtained were on two of the SCAN variables. The girls showed a significantly greater frequency of attending/participation than did the boys ($t = 2.60$, $df = 28$, $P < .02$). On the other hand, the boys engaged in more constructive play than did the girls ($t = 2.422$, $df = 28$, $P < .05$). Of particular interest was the fact that so few significant sex differences in performance were obtained, especially with regard to classroom behavior styles. For the means and standard deviations, see Table 3.

### Age Effects

A series of one-way F tests for all the variables except numbers 1 and 2 was performed on the four-, five-, and six-year-old groups. On the MFF test, the results showed significant age effects for mean latency

($F = 3.42$, $df = 2/27$, $P < .05$). In addition, there was a tendency for total errors on the MFF to decrease with age ($F = 3.09$, $df = 2/27$, $P < .10$). Thus, with an increase in age, the children tended to take more time in selecting their initial choices and to make fewer errors.

The only significant age effect on the SCAN variables was found on passive responding ($F = 10.00$, $df = 2/27$, $P < .005$). In this case the five- and six-year-olds seemed to show a relatively low level of passive responding as compared to the four-year-olds.

On the MS task, the most common strategy the children employed was that of scanning. (See Figure 1 in the Appendix.) It should be noted, however, that on some of the problems the six-year-old children were systematically eliminating alternatives by using a focusing strategy. Because of the low expected frequencies, analysis by $\chi^2$ could not be carried out.

On the PIAT there were no significant age differences at the .05 level in performance on standard scores for either Mathematics or Reading Recognition. It should be noted, however, that the use of standard scores based on a percentile ranking for a particular age group collapsed age differences. When raw scores were employed, highly significant differences by age were obtained on both Mathematics ($F = 10.45$, $df = 2/27$, $P < .005$) and Reading Recognition ($F = 18.55$, $df = 2/27$, $P < .005$). For the means and standard deviations of the preceding variables, see Table 4 in the Appendix.

It should be noted, however, that classifying the children into three different age groups tended to negate possible age effects. Thus, the interrelationships among the variables were of more interest in

the present study than were tests for mean differences in performance by age.

Relationship Among Behavioral Styles

The intercorrelations of all the variables are presented in Table 5 of the Appendix. The most important finding of the present study was the identification of a negative cluster of classroom behaviors. It was found that children who were highly attentive displayed lower frequencies of gross motor behavior and dependency. Frequency of social interaction was negatively associated with passive responding and dependency. In addition, children who were passive showed greater frequencies of aggression and nonconstructive activity. Frequency of teacher interaction was positively related to nonconstructive activity. Thus, it may be possible to identify by observational means a child whose behaviors are highly inconsistent with those of the competent child. These results are suggestive of a pattern of inattentiveness, high level of gross motor behavior, dependency, passivity, low social interaction, and aggression. In addition, it may be the case that the teacher intervenes when the child is engaged in nonconstructive activities.

On the MFF the children showed both an increase in mean latency and a decrease in the number of errors as both chronological age (CA) and mental age (MA) increased. However, there was no significant relationship at the .05 level between latency and number of errors.

In contrast to what might be expected, there was a significant relationship at the .05 level between MFF mean latency and MS mean bits of information, and between the number of MFF errors and mean time per problem in the MS task. As with the MFF, the correlation between mean

bits of information and mean time per problem was not significant at the .05 level. Mean time per problem showed a decrease with increasing age. However, no other correlations on this task with MA and CA were significant at the .05 level.

Several of the SCAN variables were significantly correlated with both CA and MA. With an increase in CA and MA, there was a decrease in the frequency of teacher interaction, passive responding, and dependency. In addition, the frequencies of attending/participation and social interaction were associated with an increase in CA, while nonconstructive activity declined with age.

Correlates of Achievement

As expected, increases in both CA and MA were positively associated with higher scores on both Reading Recognition and Mathematics. In addition, in most cases those children who were more reflective in the MFF test and were more efficient problem-solvers on the MS task obtained greater achievement scores. These later relationships must be examined, however, in view of the high correlation between MA (and CA) and most of these variables. Thus, performance on the MFF test and the MS task may reflect developmental growth.

Several measures of classroom behavior were also related to achievement on both of the scales. An increase in social interaction was associated with a greater achievement score. In contrast, passive responding and nonconstructive activity were negatively related to achievement. Frequency of teacher interaction was also negatively associated with the scores on the Reading Recognition subtest.

## Discussion and Recommendations

One of the intriguing discoveries emerging from the data in the present pilot study was the identification of a pattern of behavioral styles revealed in the observations that correlate negatively with achievement. These styles stand apart from the general and expected relationship of mental and chronological age with a variety of school-related variables.

These negative behavioral styles, indicated by the frequencies of passive responding, dependency, excess motor activity, impulsivity, etc., suggest a pattern of disorganization and immaturity that seems consistent with previous work by Schaefer (1971); Thomas, Chess, and Birch (1968); and from the Fels Longitudinal Studies (McCall, Appelbaum, and Hogarty, 1973). In each of these studies there is the suggestion that there are longitudinal patterns developing in the children that can be continuing unfavorable indicators for effective learning.

One of the specific concerns that should be pursued with further research is whether or not the open classroom, as particularly structured in North Carolina, is a good setting for such children. The present data clearly suggest that unless such a setting is modified, for children who display these disorganized and immature styles, then they may be unable to utilize the freedom of choice provided in a constructive manner.

There are two major questions of educational importance that call for further work beyond this small pilot effort. The first of these questions is, "Does such a pattern of negative behavior as illustrated here continue in children over time, and what happens to such behavior when the child enters a different learning or classroom setting?"
It is a common observation that behavior at this age level is highly

related to environmental setting, and it is possible that a different structure or different environment could yield different results. From this emerges the second major question.

"What can be done to modify the environment or the teacher behavior within the environment to reduce or eliminate these negative styles that seem so unfavorable and so negatively predictive of learning?"

The great current interest in the area of learning disabilities, its cause and cure, and the concern being expressed about the proper design of educational settings seems to call for definitive research efforts to provide solid information for decision makers on these issues of major educational significance.

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# Appendix

## Detailed Presentation of Results of Study 1

Table 1

Schedule for Classroom Activity Norms (SCAN)

| Category | Description | Examples |
|---|---|---|
| 1. Constructive Self-Directed Activity (SDA) | Independent class work which leads to a teacher-accepted product or goal. | Doing assigned seat work, reading, or writing a paper. |
| 2. Attending (AT) | Paying rapt attention during an organized classroom activity and responding appropriately to teachers's questions. | Listening carefully to a story, watch a film closely, raising hand to answer questions. |
| 3. Constructive Play (CP) | Appropriate self-directed activity which is not a part of the curriculum. | Doing educational puzzles, games, drawing. |
| 4. Task-Oriented Interaction (TOI) | Working with another peer on some academic task or assignment. | Working on a joint project, conversing about a lesson, discussing an assignment. |
| 5. Non-Constructive Activity (NCA) | Task-irrelevant self-directed activity. | Banging pencil on desk, scribbling, playing when work is assigned. |
| 6. Destractibility (DST) | Visual wandering, daydreaming. | Looking out window, looking up when child comes near, staring into space. |
| 7. Passive Responding (PR) | Inattention in group activities or passively waiting for directions or assistance. | Sitting in a group without attending closely, standing on the periphery of some activity without participating; passively watching the activities of others. |

(continued)

| Category | Description | Examples |
|---|---|---|
| 8. Gross Motor Activity (GM) | Self-directed activity involving large muscle groups including activities necessary for the execution of assignments. | Running, dancing, wandering around the classroom, pencil sharpening, looking for materials. |
| 9. Social Interaction (SI) | Conversing about things other than academic tasks. | Talking about a party, planning after-school activity, talking about a friend. |
| 10. Dependency (DEP) | Asking for or accepting help, support or praise from teacher or peers. | Asking teacher to look at work or to tell if work is correct, standing close to teacher waiting for attention, asking another child for information or assistance. |
| 11. Aggression (AGG) | Verbally or physically attacking a person or object including negative attention getting and resisting authority. | Refusing to carry out instructions, threatening, demanding, pestering, whining, name-calling, hitting, pushing. |
| 12. Teacher Interaction (TI) | Conversation with teacher that is either social in nature or initiated by the teacher. | Discussing after-school plans with teacher. Child interacting while teacher checks work. |

Table 3

Means and Standard Deviations of Variables on which there were Significant Sex Effects

| Variable | | Boys | Girls |
|---|---|---|---|
| Attending/Participation | $\bar{x}$ | 14.35 | 26.94 |
| | s | 10.04 | 15.45 |
| Constructive Play | $\bar{x}$ | 39.36 | 25.75 |
| | s | 13.30 | 16.93 |

Table 4

Means and Standard Deviations of Variables on which there were Significant Age Effects

| Variable | | Age Groups | | |
|---|---|---|---|---|
| | | 4 yr. olds | 5 yr. olds | 6 yr. olds |
| MFF Latency | $\bar{x}$ | 5.51 | 9.27 | 11.19 |
| | s | 1.70 | 3.74 | 7.53 |
| MFF Errors* | $\bar{x}$ | 22.70 | 20.60 | 16.20 |
| | s | 6.72 | 6.83 | 3.85 |
| Passive responding | $\bar{x}$ | 23.40 | 10.80 | 7.80 |
| | s | 12.08 | 5.33 | 5.60 |
| Mathematics (raw score) | $\bar{x}$ | 11.40 | 15.90 | 23.40 |
| | s | 2.99 | 4.95 | 8.49 |
| Reading Recognition (raw score) | $\bar{x}$ | 12.70 | 19.10 | 27.90 |
| | s | 4.92 | 3.03 | 7.80 |

*$P < .10$

Table 5

Correlations Among the Variables Which Were Significant at the .05 Level[1]

| | CA | MA | IQ | MFL | MFE | MST | MST | SDA | ATP | CP | TI | SI | PR | DST | TRI | GMB | NCA | AGG | DEP | MSS | RSS | MRS | RRS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CA[2] | | | | | | | | | | | | | | | | | | | | | | | |
| MA | .78 | | | | | | | | | | | | | | | | | | | | | | |
| IQ | | .43 | | | | | | | | | | | | | | | | | | | | | |
| MFL | .42 | .47 | | | | | | | | | | | | | | | | | | | | | |
| MFE | -.44 | -.48 | | | | | | | | | | | | | | | | | | | | | |
| MSI | | | | .45 | | | | | | | | | | | | | | | | | | | |
| MST | -.39 | | | | .42 | | | | | | | | | | | | | | | | | | |
| SDA | | | | .39 | | | | | | | | | | | | | | | | | | | |
| ATP | .40 | | | | | | | | | | | | | | | | | | | | | | |
| CP | | | | | | | | | -.50 | | | | | | | | | | | | | | |
| TI | | | | | | | | | | | | | | | | | | | | | | | |
| SI | .43 | | | | | | | | | | | | | | | | | | | | | | |
| PR | -.67 | -.62 | | | .47 | | | | | | | -.50 | | | | | | | | | | | |
| DST | | | | | | | | | | | | | | | | | | | | | | | |
| TRI | -.46 | -.38 | | | | | | | | | | | | | | | | | | | | | |
| GMB | | | | | | | | | -.53 | | -.36 | | | | | | | | | | | | |
| NCA | -.38 | | | | | | | | | | | | .50 | | .68 | | | | | | | | |
| AGG | | -.36 | | | | | | | | | | | .39 | | | | .41 | | | | | | |
| DEP | -.43 | -.37 | | | | | .36 | | -.40 | | | -.43 | | | | | | | | | | | |
| MSS | | | .66 | | | .46 | | | | | | | | | | | | | | | | | |
| RSS | | | .37 | | | | .44 | | | | | | | | | | | | | .43 | | | |
| MRS | .59 | .81 | .41 | .44 | -.37 | .58 | | -.38 | | | | .37 | -.48 | | | | | | | .59 | | | |
| RRS | .70 | .81 | | .38 | | .44 | | | | | | .43 | -.58 | | -.38 | | -.47 | -.36 | | | | .82 | |

[1] $p$ at least < .05.

[2] See Table 2 for the variable names.

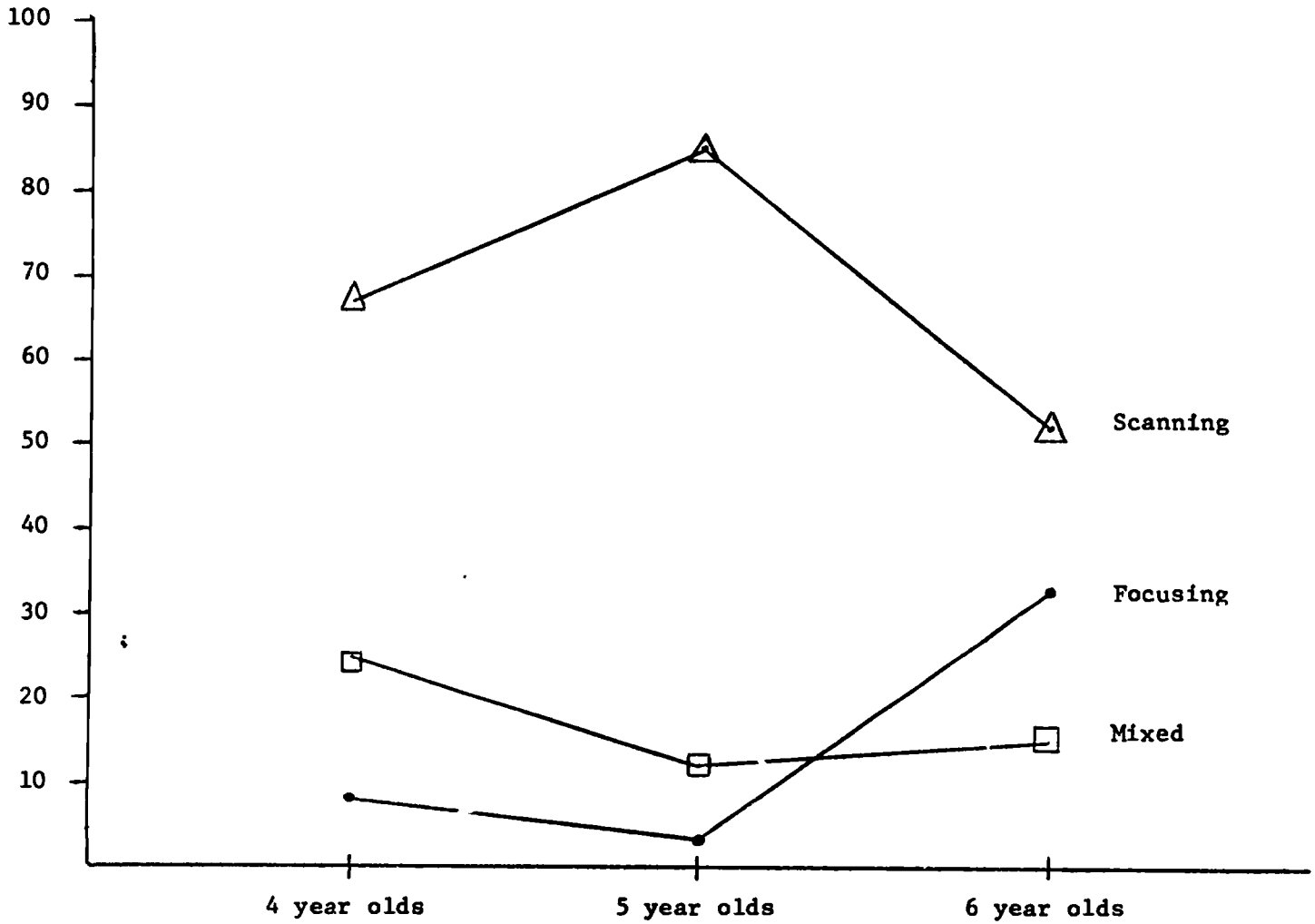


Figure 1. Proportion of each type of strategy by group.